

THE
AMERICAN REPERTORY
 OF
ARTS, SCIENCES, AND USEFUL LITERATURE.

VOL. II.

SEPTEMBER, 1831.

No. 9.

CHEMISTRY.—*Continued.*

PRINCIPLE 10.—OF ALUMINE.—Alumine is the most generally known as the basis of clay; though common clay soil contains more silex than alumine. It constitutes the chief of the basis of alum. It is a constituent of every rock stratum, excepting some lime rocks. It has been found in a pure uncombined state, but in one locality. The alum of commerce consists of alumine combined with sulphuric acid, and a little potash; from this salt the alumine may be precipitated by ammonia. Mixed with silex, alumine forms the chief part of soils, which mixture, when moistened with water, will absorb ammonia, carbonic acid gas, carburetted hydrogen gas, and all other gases which are nutritious to growing vegetables.

Acetate of alumine.—This is made by double elective affinity, with alum and sugar of lead.

PRINCIPLE 11.—OF GLYCINE.—Glycine is found in emerald or beryl. It is capable of becoming a slightly adhesive paste in water. It is dissolved in the alkalies. All the salts of which it forms the basis, are sweetish, and somewhat astringent. Not used in the arts.

PRINCIPLE 12.—OF ZIRCON.—Zircon is found in granite and in gneiss, in the form of four-sided prisms. The pure zircon is insoluble in water, but unites with all the acids. Soluble in no pure alkali, but is soluble in their carbonates. Not used in the arts.

PRINCIPLE 13.—OF YTTRIA.—This is found in gadolinite, in Sweden. It is combined with silex, oxyd of cerium, and oxyd of iron. When pure, it is insoluble in water, soluble in most acids, also in the carbonate of ammonia.

PRINCIPLE 14.—OF THORINA.—Thorina was lately discovered by

Berzelius, in the gadolinite of Sweden. It resembles zircon. Its salts are astringent, but not sweet. It is extremely rare, and not used in the arts.

CLASS 5.—METALS.

The specific gravity of all pure metals is above five. They all reflect light brilliantly, which reflection is called the metallic lustre. Most of them are found in the earth, combined with oxygen or sulphur. All may become sulphurets, by heating with sulphur, as directed in preparing sulphuretted hydrogen gas.

Metals may be combined or alloyed together, in which state their fusibility is increased. All metals must be in the state of oxyds before they can combine with acids and form salts. Metals may be oxydated by the decomposition of acids or of water, or they may have been previously oxydated by some other process. In some cases a metal is first oxydated by an acid which it can decompose, and then united to a different one by double decomposition. Metals, when made as cold as possible, give off caloric, if their particles are made to approach each other. Letters may be etched upon metals, by converting the surface, where the strokes are to be etched, or the interstices between them, into oxyds. Metallic salts may be decomposed very readily by alkaline salts.

SECTION 1.—*Metals which absorb oxygen with such force as to decompose water, when heated to redness.*

PRINCIPLE 1.—**IRON.**—Iron is distinguished in the arts by three general kinds; *cast iron, wrought iron, and steel.* Cast iron contains carbon, and is of a brittle granulated structure. If cast iron is melted and stirred while in fusion, part of the carbon is burned out. When hammered and rolled, it is called wrought iron. Wrought iron may be converted into steel, by heating it in contact with charcoal, with which it combines: on heating and plunging it into cold water, it becomes more fusible. Iron enters into another state of combination with carbon, forming the plumbago or black lead. Oxyds of iron form the basis of most colours in minerals and vegetables. Iron is rarely found pure. It is most generally found in the state of an oxyd or a sulphuret; though it is found in the state of a carbonate, sulphate, &c. In the oldest primitive rocks, it is found in the state of a protoxyd, and is considerably magnetic. In secondary rocks and alluvial deposits, it is often found in the state of a

Plumbago

Argillaceous iron ore. peroxyd, and compounded with clay. It is then called argillaceous iron ore.

Hematitic oxyd of iron. In the more recent primitive formations, it is found in a mixed state, consisting of the protoxyd and peroxyd, in various proportions. It is then called hematitic oxyd of iron.

Steel may be distinguished from iron, by the action of an acid upon its carbon. The acid on the iron will be whitish, on the steel, dark brown or black. Iron becomes oxydated on exposure to air and water; and the red oxyd, or iron rust, thus made, always contains some carbonate of iron in combination. Though iron is mineralized with sulphur, oxygen, and carbonic acid, it does not enter into many alloys. The principal alloy of iron known in the arts, is that of the sheet tin.

PRINCIPLE 2.—MANGANESE.—Manganese is found in the state of a peroxyd. It often accompanies the hematitic iron ore. It is generally found in the most recent primitive rocks, or in alluvial deposits, consisting of these rocks in a state of disintegration. The peroxyd of manganese, (usually called the black oxyd,) readily gives off its highest portion of oxygen on being subjected to the red heat of iron. This peroxyd is reduced to the protoxyd, and oxygen given off, by the application of an acid, which combines with the protoxyd only.

PRINCIPLE 3.—TIN.—Tin has not yet been found on the continent of America, except a small quantity in Mexico. The most extensive mine, is that of Cornwall, in England. It is found in other places in small quantities. It is mostly in the state of an oxyd. The tin foil is pretty pure, and the grain tin considerably so. Tin alloyed with lead forms pewter. But it is most extensively used for covering the surface of thin sheets of iron, called sheet tin.

Tin is not oxydated at the common temperature. Lightning rods are tipped with this, to prevent the points from rusting. Copper vessels are tinned inside for the same reason. When heated so as to be brought to the state of fusion, it becomes oxydated. It combines with mercury at the common temperature; and at the time of its amalgamation with mercury will adhere to glass.

With iron, tin will form an imperfect alloy. Dissolved in nitro-muriatic acid, (aqua regia,) it forms

Muriate of tin. the muriate of tin; used for giving cochineal the scarlet colour.

PRINCIPLE 4.—ZINC.—Zinc is mostly found in the state of a sulphuret. It accompanies lead in most mines. In the Southampton lead mines it is found in granite and gneiss. Alloyed with copper it forms brass. It has a strong attraction for oxygen; by the aid of sulphuric acid, it rapidly decomposes water. On account of its strong attraction for oxygen, it is used for the positive sides of the pairs of metallic plates in a galvanic battery. Zinc, on being melted and boiled in contact with atmospheric air, forms a white oxyd, very light and flocculent. It unites with sulphuric acid and

White vitriol. forms sulphate of zinc, called white vitriol.

PRINCIPLE 5.—CADMIUM.—Stromeyer lately discovered cadmium in carbonate of zinc. It resembles tin in not being oxydated at the common temperature, in being flexible and ductile.

It is harder, however, and more tenacious. It is precipitated by zinc, in a foliaceous form, like lead.

SECTION 2.—Metals which absorb oxygen, but not with sufficient force to decompose water. (May become acids capable of combining with salifiable bases.)

Five of the metals of this section may themselves become acids, and unite with other metals and metalloids; not as alloys, but as acids forming salts with them. The other seven cannot become acids. Copper is more useful in the arts, than all the other eleven metals of the section.

PRINCIPLE 6.—ARSENIC.—Arseniate of cobalt is not uncommon in the hornblend rocks of this country. It is found in Hungary, &c. in the state of a red sulphuret, called *realgar*; and in the state of a yellow sulphuret, called *orpiment*. It is a deadly poison in the state of *arsenious acid*, which is the solid substance commonly called the white oxyd of arsenic.

Artificial orpiment.—This is formed by uniting arsenic with sulphur. Arsenious acid, when thrown on ignited charcoal, gives off the scent of garlic.

PRINCIPLE 7.—CHROME.—Chrome is found in the state of an acid, combined with iron, called the chromate of iron. It is generally found in talcose rocks, or in granular lime rocks, which contain serpentine. Chromate of iron pulverized, mixed with nitrate of potash, and heated to redness, becomes doubly decomposed, and produces the chromate of potash. This chromate is decomposed by metallic salts.

PRINCIPLE 8.—MOLYBDENA.—Molybdena is found in the state of a sulphuret, in rocks of granite and gneiss, in numerous localities in the United States. It is reduced to the metallic state with much difficulty. It is then soluble in no acid, but nitric and nitro-muriatic. It is not used in the arts.

PRINCIPLE 9.—TUNGSTEN.—It is found in rocks of granite and gneiss, in Huntingdon in Connecticut, in the state of an oxyd. It is scarcely soluble in nitric acid, and not at all in any other acid. It is scarcely fusible in very high heat. It is capable of uniting with most other metals in the state of an acid. Not used in the arts.

PRINCIPLE 10.—COLUMBIUM.—Columbium has been found in the state of an oxyd, in Sweden and in America. Though it may be alloyed with iron and tungsten, it has not hitherto been dissolved in any acid. Not used in the arts.

Not capable of becoming acids.

PRINCIPLE 11.—COPPER.—Copper is found native in many places. It is also pretty common in the state of a sulphuret and a carbonate. Copper alloyed with from 12 to 18 per cent. of zinc, forms *brass*. When the proportion of copper is larger, it forms *pinchbeck*. Six parts of copper, two of tin, and one of arsenic, form *speculum metal*. Three parts of copper, with one of tin, form *bell metal*; and for little shrill sleigh-bells, &c. a little zinc is added. Copper and tin form *bronze* also, consisting of ten parts copper to one of tin. It is not much used in the arts.

Brass.

Pinchbeck.

Speculum metal.

Bell-metal.

Bronze.

Copper long exposed to moisture in a damp place, becomes a green carbonate at the surface. Vinegar will both oxydate copper, and form with it the salt called *verdegriis*, (or acetate of copper.) Copper has a strong affinity for ammonia, with which it will combine when in the state of salts, or otherwise, and form various coloured compounds. Combined with arsenious acid, it forms Scheele's green.

PRINCIPLE 12.—ANTIMONY.—Antimony sold at the shops, is in the state of a sulphuret generally. It exhibits a crystalline form; being mostly in needle form crystals. When taken into the stomach in almost any form, it causes vomiting. It does not contract so much on cooling as most other metals; it is therefore useful in the manufacture of printer's types. Sulphuret of antimony will decompose water and form sulphuretted hydrogen gas.

Tartrate of antimony. Oxyd of antimony will combine with tartaric acid, and form the tartrate of antimony, called tartar emetic.

PRINCIPLE 13.—BISMUTH.—Bismuth is found in a pure metallic state, in Huntingdon, Connecticut. A pretty large specimen was found among the pebbles in a stream of water near lake George. It is found in mines of gold, with copper, &c. but is not very abundant. It combines with nitric acid, and forms nitrate of bismuth, the most delicate sympathetic ink. Warmth renders this ink invisible; water renders it visible. Water precipitates oxyd of bismuth from liquid nitrate of bismuth.

Nitrate of bismuth.

PRINCIPLE 14.—COBALT.—Cobalt is found combined with arsenic and with sulphur, in hornblende rock. It is sold in the shops in the state of an imperfect oxyd, called zaffre. The pure metal is reddish grey. The zaffre gives to glass, or to an alkali, a violet blue colour. A blue or green sympathetic ink is made with zaffre and muriatic acid. Cold renders this ink invisible; warmth, visible.

PRINCIPLE 15.—TITANIUM.—Titanium is always found in the state of an oxyd, in primitive rocks, particularly with tremalite in granular limestone. It is always brownish red, very difficult to reduce, and its properties little known.

PRINCIPLE 16.—TELLURIUM.—Tellurium is always more or less alloyed with other metals. It is chiefly found in Transylvania. It burns with a bluish flame before the blow-pipe, giving the odour of horse radish.

PRINCIPLE 17.—CERIUM.—Cerium is found in Sweden, in the state of an oxyd. The protoxyd is white, the peroxyd is red. It has scarcely ever been reduced to the metallic state. The peroxyd is generally combined with silic.

PRINCIPLE 18.—URANIUM.—Uranium is found in the state of a black oxyd and of a green oxyd. The green oxyd is a beautiful mineral; but it is extremely difficult to reduce either of the oxyds to the metallic state. It is not used in the arts.

SECTION 3.—Metals which do not receive oxygen, excepting from strong acids.

PRINCIPLE 19.—GOLD.—Gold is never found mineralized, but almost always in the state of an alloy with silver, or with some other metal. It cannot be tarnished by oxydation on exposure to water or the atmosphere. It may be dissolved by nitro-muriatic and oxy-muriatic acids, and by no other acid. Iron, copper, and silver may be covered with a thin coat of gold, which

is called gilding. Adulterations of gold coin may be detected, without an analysis, by taking the specific gravity.

PRINCIPLE 20.—**SILVER.**—Silver is found alloyed and mineralized with numerous substances. Sulphur, alumine, antimony, lead, arsenic, copper, mercury, carbonic acid, muriatic acid, &c. have been found combined with silver. It cannot be tarnished with oxygen by any exposure at the common temperature. It is very malleable and ductile, but not so ductile as gold. Silver coin is alloyed with copper, as $12\frac{1}{2}$ to 1; from which alloy, silver may be obtained pure, by forming a nitrate of it, and then precipitating it by solid metallic copper.

Nitrate of Silver.—This, called also lunar caustic, or lapis infernalis, is formed by combining silver with nitric acid. Nitrate of silver heated with alcohol, and an additional portion of nitric acid, may be formed into an explosive or fulminating powder.

PRINCIPLE 21.—**PLATINA.**—Platina has always been found in small grains, in alluvial formations. It is never found pure, but is alloyed with iron, copper, lead, osmium, rhodium, iridium, and palladium; though these alloys constitute but a small part of the mass of the ore. Platina is the heaviest of all metals, least expandible by heat, most difficult to melt or to unite to oxygen. It is therefore preferable to all metals for pendulum rods, for inch measures, crucibles, reflecting telescopes, and conductors for the galvanic battery. Being the most fixed and infusible of all metals, it is polished and used as a concave reflector in the most powerful telescopes, where glass would melt or break. For crucibles and other uses it is employed in the laboratory. Platina may be dissolved in nitro-muriatic acid, and will then form muriate of platina, which is a test for potash.

Muriate of platina.

PRINCIPLE 22.—**OSMIUM.**—Osmium is found in small quantities, alloyed with platina. A black powder remains after dissolving the grains of platina in nitro-muriatic acid. If this powder be heated with salt-petre, the oxyd of osmium is sublimed, which gives a very pungent odour. It is very soluble in water, and becomes purple with an infusion of galls. It gives up its oxygen to all the metals but gold and platina.

PRINCIPLE 23.—**IRIDIUM.**—Iridium is always alloyed with osmium, and associated with native platina of South America. It is scarcely acted upon, or not at all, by nitro-mu-

riatic acid. By fusion with potash, it becomes oxydated; and then it is soluble in the three strong acids. It is not used in the arts.

PRINCIPLE 24.—PALLADIUM.—Palladium is found in grains of platina and gold, in Brazil. It resembles platina more nearly than any other metal. But its specific gravity is but about half that of platina. With nitro-muriatic acid it forms a deep red solution. Not used in the arts.

PRINCIPLE 25.—RHODIUM.—Rhodium is not malleable, is infusible and insoluble in acids; but it is soluble in nitro-muriatic acid, when alloyed with copper, lead, or platina. Not used in the arts.

SECTION 4.—*Metals which absorb oxygen at limited temperatures, and give it wholly off at higher temperatures.*

PRINCIPLE 26.—MERCURY.—This is the quicksilver, or *argentum vivum*, of old authors. It is generally found in secondary rocks, in the state of a sulphuret, called cinnabar. It is in the solid state at about 40 degrees below zero, that is, about 72 below freezing; it is in the liquid state to about 600 above freezing, when it is evaporated. The black oxyd or protoxyd of mercury is produced by agitating mercury in contact with atmospheric air, or by precipitating it from calomel with potash. The nitrate of mercury may be reduced by heat to the nitric oxyd of mercury, called red precipitate. Sulphur and mercury will unite without heat by being rubbed together, and form the black sulphuret called *Æthiop's mineral*. If per-sulphate of mercury and muriate of soda, be rubbed together, a double decomposition will take place, and per-muriate of mercury, called corrosive sublimate, will be produced.

Protoxyd of mercury.

Red precipitate.

Æthiop's mineral.

Per-muriate of mercury.

Animal albumen reduces corrosive sublimate to imperfect calomel. If a person accidentally takes corrosive sublimate into the stomach, and discovers it immediately, he may probably check the poisonous effect by swallowing the white of several eggs. Milk or blood, if taken in the stomach freely may check its operation.

PRINCIPLE 27.—LEAD.—Lead is generally found mineralized with sulphur, in an ore called galena. It is much used in the arts in the metallic state. It is alloyed with tin, forming pewter. Good pewter consists of one part lead, to four of tin; but most of the pewter of the present day is chiefly lead. Solder, called plumber's solder, consists of equal parts of lead and tin, melted

together. Lead receives its lowest proportion of oxygen at a low red heat, while exposed to atmospheric air; also, from the decomposition of an acid, with which it is combined, as the base of a salt. By raising the heat very high, oxyd of lead gives its oxygen wholly off, and becomes pure lead again.

White lead. Carbonate of lead, called white lead, is formed by double decomposition, or mixing nitrate of lead and pearlsh. White lead, carbonate of lead, dissolved in vinegar, forms sugar of lead. Lead is precipitated from the state of a salt, in the metallic state, by metallic zinc.

Sugar of lead.

PRINCIPLE 28.—NICKEL.—Nickel is generally obtained from the sulphuret. It is found alloyed with tin in meteoric stones. Its colour, when pure, is between those of silver and tin; but it generally exhibits a pale flesh coloured tinge. Ure says it is magnetic. Others differ in opinion on this subject. Accum, Chenevix, and others, say it is the iron which is alloyed with the nickel, that attracts the magnet. It is a rare metal. With nitric acid, it forms a salt, which may be made to exhibit several colours.

ORGANIC SUBSTANCES.—Under organic substances are included the subjects of the vegetable and animal kingdoms. The constituents of vegetable and animal matter, are properly divided into *proximate* and *ultimate elements*.

Proximate elements. The proximate elements, are those compounds into which animal and vegetable matter may be resolved, and still retain properties most nearly resembling these organic substances, before they were subjected to the process of decomposition. Such as resin, starch, gum, glue, albumen, oil, &c. The ultimate elements are the simple substances into which they may be resolved, by a thorough analysis. Such as oxygen, carbon, &c.

Ultimate elements.

Two active principles, the *living principle*, and the principle of *chemical affinity*, are perpetually at war with each other. The latter is disposed to derange the organic structure, and to form new chemical compounds. But the former is more powerful, and resists the incessant attacks of the latter. Chemical affinity is exerting its energies every moment of our lives to convert our bodies into the most odious gases, and inorganic liquids and solids. But the living principle maintains its empire for a few years. At last, yielding to the unabating efforts of chemical affinity, the most beautiful face loses its youthful glow, and the

speaking eye loses its brilliancy. They are given over to form the constituent elements of sulphuretted hydrogen, carburetted hydrogen, carbonic acid, ammonia, and other inorganic substances.

VEGETABLE SUBSTANCES.—*Ultimate elements.*—Vegetable matter is essentially composed of carbon, oxygen, and hydrogen. When it is heated in a retort to that degree, which is called destructive distillation, the constituent elements assume new arrangements; and carbonic acid, carbonic oxyd, carburetted hydrogen, empyneumatic oil, water, &c. come over, leaving charcoal, and generally, some earths and salts in the retort.

Proximate elements.—These elements may be distributed into five divisions by a trial of their solubility. Illustration: dissolve, or attempt to dissolve one or more of the elements of each division; if the solution is made, precipitate it by adding an excess of a substance which is not its solvent. Application: when any of the proximate elements enumerated below, are to be used, let them be brought to the liquid state, or precipitated, as their application may require.

FIRST DIVISION.—Proximate elements, which are soluble in cold water.

Acids, sugar, gum, jelly, colouring principle, bitter principle, nicotin, extractive matter, emetin.

SECOND DIVISION.—Proximate elements which are insoluble in cold water, but partially soluble in hot water.

Morphia, cerasin, starch, indigo, gluten, pollenin, fibrin.

THIRD DIVISION.—Proximate elements which are insoluble in water, and melt and burn when heated. Most of them are soluble in alcohol.

Fixed oil, wax, volatile oil, camphor, resin, guaiacum, balsam, gum-resin, caoutchouc, bitumen.

FOURTH DIVISION.—Proximate elements which are not soluble either in water, alcohol, or ether; having a fibrous or woody texture.

Cotton, cork, pitch, wood, fungus.

FIFTH DIVISION.—Extraneous substances sometimes found in vegetables.

Mineral acids, alkalies, earths, metals.

PRODUCTS OF FERMENTATION.—Some vegetable solutions will undergo spontaneous changes, whereby alcohol or vinegar is produced; during this process, carbonic acid gas is evolved.

Illustration: put some sugar into a Florence flask,

and dissolve it with about five times as much warm water, and add a little yeast. Set it where it will continue to be warm, but not hot. Let one end of a bent tin or glass tube be fitted into the flask by perforating a sound cork, and let the other end pass under the moveable shelf of the cistern. After standing a while, a gas will begin to come over. As soon as the atmospheric air has passed out, begin to collect the gas. On testing it with lime water, it will be found to be carbonic acid gas.

Application: from this experiment it appears, that sugar alone is sufficient to produce fermentation with water, when started with yeast. It is found that sugar is essential by many trials. This is the same gas which issues from cider, beer, &c. when fermenting: it is also produced in dough, when rising.

The intoxicating substance, called alcohol, is produced during fermentation. Alcohol being converted into vapour with less heat than water, it may be distilled over by a due degree of heat. Thus, rum, brandy, gin, cider-brandy, &c. are obtained.

Cider is sometimes boiled down for family use; as for making apple preserves, &c. This should always be done before fermentation commences; because alcohol will then be formed, which will be driven off and wasted by evaporation, while boiling down the cider.

Ardent Spirits.—The ardent spirits of commerce consist of alcohol combined with water, and some other kind of adulterating substances, giving each kind its peculiar flavour; from either of which, pure alcohol may be obtained by re-distillation, and the absorbing power of potash.

Alcohol has such a strong affinity for water, that on mixing them, they unite so closely as to diminish their measure, or volume. Boiled with sulphuric acid, it produces a light volatile compound, called ether. Ether is extremely volatile; so that if a part of the atmospheric pressure is taken off, it will boil with the warmth of the hand. Illustration: put a little ether into a long-necked vial; a cologne vial is best. Heat the vial so that it can hardly be borne by the hand, while its mouth is open. Then put in the cork perfectly tight. Now if the warm hand be clasped around the neck of the vial, and it be held with the bottom up, the ether will boil.

Fermented liquids which produce alcohol, will un-

Vinegar.

dergo a second fermentation, if exposed to warm atmospheric air; in which state the alcohol will be destroyed, and vinegar will be produced. Illustration: expose a little cider, strong beer, or wine, to a summer's sun, or to the air of a warm room in an open bowl, or an earthen plate, and in a few days, or sometimes in a few hours, it will become acetous, and lose all its alcoholic principle. Application: upon this principle, common vinegar is made. Oxygen is absorbed from the atmosphere, which is supposed to unite with and carry off another proportion of carbon, in the state of carbonic acid gas. Pure acetic acid consists of 46.82 oxygen, 6.35 hydrogen, 48.83 carbon.

Pyroligneous acid.

If good sound wood be heated in a confined situation, as in a gun barrel, &c. the *pyroligneous* acid comes over, which makes good vinegar, when separated from several impurities, which come over with it. Vast quantities of this acid are produced in the manufacture of charcoal for making gun-powder.

ANIMAL SUBSTANCES.—*Ultimate elements.*—The essential ultimate elements of animal substances, are carbon, oxygen, hydrogen, and nitrogen. Generally sulphur and phosphorus are found in animal matter.

The addition of *nitrogen* causes the most important distinction between animal and vegetable substance. It being one of the constituents of ammonia, it gives rise to that gas, during the decomposition of animals, by the process called putrefaction. Several other substances are frequently found in animal matter; as, oxyd of iron, lime, soda, potash, &c.

PROXIMATE ELEMENTS.—The most important proximate elements of animal substances are gelatine, albumen, fibrin, and oil.

BONES AND SHELLS.—*Internal bones.*—Internal bones of animals consist mostly of phosphate of lime. They contain a little carbonate of lime and some animal matter.

External shells.—External shells of animals are chiefly carbonate of lime. They generally contain a little phosphate of lime, and some animal matter. These animals which are covered with an external crust, as the lobster, &c. have their covering chiefly made up of near equal proportions of carbonate of lime, and phosphate of lime, which contains a larger proportion of animal matter.

RESPIRATION.—Oxygen changes the dark colour of the blood of the veins, to the scarlet colour of arterial blood. Illustration: drop a small mass of dark clotted blood into

a vial of carbonic acid gas, and another mass into a vial of oxygen. Place the fingers over the mouth of each, and shake them pretty hard. The blood in the oxygen will become scarlet coloured, while that in the carbonic acid will remain dark coloured. If atmospheric air is now substituted for oxygen, and another portion put in, it will become scarlet coloured, but not so bright.

Application: it appears from this experiment, that oxygen may affect the blood in respiration, so as to produce the necessary change required, (at least in colour,) for rendering it a fit material for supplying the waste of the system.

Atmospheric air.—Atmospheric air suffers a diminution of bulk by respiration; and the oxygen is consumed or diminished in quantity. A crowded assembly in a close room, consumes the oxygen, and gives off carbonic acid gas. The excess of nitrogen ascends to the upper ceiling, while the carbonic acid settles down near the floor. Consequently, the purest air, or that which contains most oxygen, is between the two.

Animal Effluvia.—Animal effluvia, arising from the beds of the sick, or from other sources, may be neutralized by the strong acids in the state of gas. Illustration: it seems to be proved by observation, that such effluvia are combined with aqueous vapour. The ready union of aqueous vapour and the strong acids, in the state of gas, will appear, by first pouring a tea-spoonful of muriatic acid upon a red hot iron shovel, and then pouring a wine glass of water upon it. The acid will rise up in the state of a suffocating gas, and the water will follow it in the state of vapour, and absorb it almost instantaneously, so that the suffocating gas will wholly disappear. Application: contagious vapour, arising from the beds of the sick, the marsh miasmata, (carburetted hydrogen combined with aqueous vapour,) and other pestilential effluvia, may be neutralized as follows. Remove the sick and other persons from the room. Set a tea-cup or gallipot on the floor, half filled with table salt. Pour into it strong sulphuric acid, and the room will be filled with muriatic acid gas. After a few minutes, open the windows, and the air of the room will be purified.

ACIDS.—Animal matter highly heated in contact with potash, will yield the prussic acid, (the most active of all known poisons,) and the prussiate of potash will be formed. Illustration: put some shavings of hides, which may

be procured at the tanners, into a crucible, and invert another crucible over it. Heat it until it becomes considerably charred, then take it out and reduce it to a coarse powder. Boil some potash in a ladle, and continue the heat until the potash is reduced to a dry granulated mass. Mix the two substances in about equal parts, and heat the mixture in a ladle pretty closely covered with a sheet of iron. Raise the heat until the blaze which leaks out under the cover, becomes whitish, or nearly colourless. Now pour this mass into boiling water, and continue the heat some time. Skim off all carbonaceous and other substances which rise to the surface. When no more rises, stop the heat. This is the liquid prussiate of potash. It may be evaporated and form imperfect crystals. Application: this is the most delicate test for detecting the presence of iron.

Prussiate of iron.

A solution of prussiate of potash, will form the prussiate of iron, (prussian blue,) by double decomposition with a solution of sulphate of iron. Illustration: dissolve some copperas in a wine glass, and an extremely small piece of prussiate of potash in another. Put a drop of the solution of prussiate of potash into the copperas, and a prussian blue precipitate will be formed. Application: on the principle of the two last experiments, the prussian blue is manufactured in the large way.

Prussiate of mercury.

Prussiate of potash may be decomposed, and prussiate of mercury formed, by boiling it with nitric oxyd of mercury, (red precipitate.) Illustration: pulverize some common prussian blue, and put it into a Florence flask. Put in about half and one eighth as much red precipitate. Then pour in about three times as much pure water, (calling a pint a pound,) as of the prussian blue; and boil the mixture until the red precipitate entirely disappears. This will produce the prussiate of mercury in its liquid state. It may be strained through paper, and about one fourth as much boiling water as was put in at first, may be added. Application: this salt is not much used, excepting for the purpose of procuring pure prussic acid. For this use, it is best to keep it in the liquid state, as above directed to be made, closely corked up in vials.

Prussic acid may be obtained from the prussiate of mercury by heat. Application: this substance is lately used in consumptive cases. Two or three drops

are diluted in a large quantity of water. It is the most active narcotic known. Two or three drops on a large dog's tongue, or in the corner of its eye, will kill it in one or two seconds. A small quantity is found in the meats of almonds, peach stones, cherry bark, the laurus cerasus, &c. And the scent of the prussic acid considerably resembles the odour of these vegetables. The basis of this acid is found by Guy Lussac to consist of carbon and nitrogen. It is the carburet of nitrogen, by some called cyanogen.

Cyanogen.

Sebacic acid.—It is this acid which is so readily produced by butter or fat, giving it a disagreeable rancid flavour. Butter with this flavour is called frowey butter in New England. This acid may be neutralized by any of the alkalis. Pearlash or carbonate of soda will do it effectually. If a little pearlash be dissolved in water, and the butter be worked over with this water, all the sebacic acid will combine with the potash, and form a soluble salt. If the butter is then worked over two or three times with pure water, the sebaceate of potash, as well as the pearlash, will be worked out, leaving the butter pure. If cakes, &c. be shortened with frowey butter, and pearlash be added, the sebacic acid will decompose some of the pearlash, and thereby furnish carbonic acid to assist in raising the dough. This is the best method of using rancid butter or fat. Because the alkali may sometimes be tasted after it has been applied for cleansing as before described; but when used for shortening, it cannot.

ANALYSIS.

OF MINERALS, MINERAL WATERS AND SOILS.—The presence of common metals may be detected, without much difficulty. The substances which are usually held in solution in the mineral waters of our country, may also be detected without a laborious process.

ANALYSIS OF MINERALS.—As the hydro-sulphuret of ammonia will precipitate the oxyds of all metals, which form the basis of salts, the colours of the precipitates may assist in detecting metals. Illustration: put very dilute solutions of several metallic salts, (as copperas, blue vitriol, white vitriol, sugar of lead, lunar caustic, &c.) into separate wine glasses, and pour an extremely small quantity of hydro-sulphuret of ammonia into each, and observe the different coloured precipitates. Application: dissolve a supposed metal in an acid, as sulphuric, muriatic, nitric, or nitro-muriatic. Prepare

a solution of a known metallic salt, having a base of that metal which is suspected to be under examination. Pour some hydro-sulphuret of ammonia into both, and compare the colours, densities, and other characters of the precipitate. Although this will not always form conclusive evidence, it will assist in directing the judgment.

An infusion of galls will precipitate the oxyds of many of the metals, which form the basis of salts; and the colours of the precipitates may assist in detecting such metals. Illustration: rasp off a quantity of nut-gall, and soak it an hour or two in pure water. Strain off the liquid and put it into a phial for use. Dissolve several metallic salts, as directed in the last experiment, and precipitate the oxyds of the metals from their acids, with the infusion of the nut-galls, and observe the colour of the precipitates. Application: metals may be tested by being reduced to salts, and by collateral or comparison experiments, as directed when using the hydro-sulphuret of ammonia. It must be understood, that the same metal sometimes gives different coloured precipitates, when in different degrees of oxydation. The following are some of the colours as taken from Brande. With the proto-muriate of *manganese*, dirty yellow—proto-sulphate of *iron*, purple—per-muriate of *iron*, black—muriate of *tin*, dirty yellow—proto-muriate of *tin*, (acid.) straw colour—per-muriate of *tin*, (acid.) fawn colour—proto-muriate of *copper*, yellow brown—per-nitrate of *copper*, grass green—nitrate of *lead*, dingy yellow—tartrate of *antimony* and *potash*, straw colour—tartrate of *bismuth* and *potash*, yellow—sulphate of *uranium*, bluish black—muriate of *titanium*, blood red—white oxyd of *arsenic*, scarcely changed—any salt of *molybdena*, brown—sulphate of *nickel*, green—proto-nitrate and per-nitrate of *mercury*, (acid.) yellow—nitrate of *silver*, curdy becoming brown—muriate of *platina*, brownish green—muriate of *gold*, wine colour.

These ten tests, together with the characters of the metals, given under their respective heads, are sufficient for common use. These tests will apply to the analysis of mineral waters, when any of these metallic salts are suspected in them.

ANALYSIS OF MINERAL WATERS.—The following directions are sufficient for detecting those substances which most commonly occur, and in the largest proportions in the United States. In searching for any of these sub-

stances, it is advisable to use the test for that first, which we have the most reason to expect.

MURIATE OF LIME.—*Nitrate of silver* in solution, dropped into the water, gives a dense white cloud if it contains muriatic acid. *Oxalic acid* gives a light white cloud, if it contains lime. Oxalate of ammonia is better.

SULPHURETTED HYDROGEN.—*Acetate of lead* in solution, is precipitated dark brown.

CARBONATE OF IRON.—*Tincture of galls* gives a dark purple, and at length a brown colour if it contains iron. *Boiling* will drive off the carbonic acid, so that after it has stood a while, the iron will be so completely precipitated, that the supernatant liquid will not give the test with tincture of galls.

SULPHATE OF IRON.—*Tincture of galls* gives the brown colour, both before and after boiling.

FREE CARBONIC ACID.—*Lime water* gives a white cloud before boiling, but produces no effect after boiling.

SULPHATE OF MAGNESIA.—*Muriate of barytes* gives a cloud, if water contains sulphuric acid. If *red cabbage* does not give the acid test, the sulphuric acid is combined with a base. If the *tincture of galls* and *oxalic acid* give no test of iron or lime, we may presume the base to be magnesia. To be more sure, evaporate the water by a very gradual heat, and taste the dried residuum. If it has a bitter taste, it will be a confirmation of the tests.

MURIATE OF SODA.—Test the muriatic acid by *nitrate of silver*. If *oxalic acid* does not give the test of lime, evaporate it slowly to dryness, and taste it. No one can mistake the taste of common salt.

Incompatible salts.—These are often mentioned in books. But these incompatible salts often exist together while the water is cold; but as soon as the water is heated, decompositions take place. If *lead* be suspected in water which has passed through leaden aqueducts, pass *sulphuretted hydrogen gas* into a portion of it, and if it contains lead, it will instantly exhibit a dark brown tinge.

If *copper* is suspected in water, or in any article of diet which has stood in a copper vessel, pour into it liquid ammonia, and it will become blue.

Collateral experiments should always be instituted upon known substances, which are similar to those for which we are searching. In doing this, we should make use of very minute portions; because large quantities may alter the appearance.

When it is required merely to know whether the water is of that kind called hard water, without regard to the kind of substances held in solution, dissolve a small piece of fine hard soap in alcohol, and pour a few drops of this solution into the water. If it is hard water, it will become milky—if not, it will remain limpid.

ANALYSIS OF SOILS.—The object in analysing soils, is to ascertain the constituents of soils, so far as such constituents have any influence upon the growth of plants. Such constituents may be,

1. *Stones* above the diameter of the fourth of an inch. These stones serve to prevent the soil from becoming too compact, and to retain moisture on their surfaces; and in some instances, to condense floating vapour, when at the surface of the soil.
2. *Pebbles* below the diameter of the fourth of an inch. These serve for most of the uses of stones; and being of a more suitable size, are more useful in keeping the soil in a kind of loose porous state, adapted to the extension of roots and transmission of moisture. The constituent elements of stones or pebbles, can have no influence on the productiveness of soils; unless reference is had to the future changes, to be effected by their future disintegration. A pebble of diamond, sapphire, or quartz, will have the same influence upon vegetation; though on an ultimate analysis, the first would give carbon, the second alumine, and the third silix.
3. *Siliceous soils.*—This has such a feeble attraction for water, that it will remain but a short time suspended in it. Such a soil scarcely suffers by a wet season, and does not suffer severely by a drought. It never “winter kills” wheat. But it is not a rich soil.
1. *Aluminous soil.*—This is always in the state of an impalpable powder. It attracts water so strongly, that it will remain long suspended in water. Such a soil is too soft in a rainy season, and bakes hard in a dry season. It requires a due mixture with siliceous soil.
5. *Lime soil.*—A soil which abounds in carbonate of lime. This may be considered as a permanent manure. Its ultimate disintegration enriches soils.
6. *Soluble salts.*—Most salts of this kind promote the speedy growth of plants. These, together with some insoluble salts, as gypsum, pulverized marble, &c. act as stimuli, and cause vegetables to seize speedily upon any nutri-

ment within their reach, as a glass of brandy excites strong appetite in a healthy labourer.

7. Animal and vegetable matter.—The basis of these substances is chiefly carbon. But the whole not only furnishes nutriment directly to plants, but absorbs from the atmosphere those gases which are highly nutritive to them.

8. Water.—Some soils hold more water than others, between the drying heat of the sun and a heat sufficient to char dry combustible vegetables. Such soils will resist the ill effects of a drought.

9. Oxyd of iron.—This is always found in soils; but its effects on vegetation seem not to be settled.

10. Powers of retaining water, so as to remain mechanically suspended in it.—This seems not to depend wholly on the proportion of the alumine. And whenever any soil, or any portion of it, will remain suspended in water over four hours, wheat sown in it is often "winter killed." Average specimens of soil from near Albany and Troy, New York.

Upland loam.—Silix, 67 per cent.; alumine, 22; carbonate of lime, 1; soluble salts, 1; decomposed animal and vegetable matter, 5; water, 4=100.—Settled clear in four hours.

Best lowland loam.—Silix, 55; alumine, 25; carbonate of lime, 2; soluble salts, 1; decomposed animal and vegetable matter, 12; water, 4=100.—Settled clear in three hours.

Best river alluvion.—Where water stands three or four feet below the surface. Silix, 75; alumine, 7; carbonate of lime, 3; soluble salts, 1; decomposed animal and vegetable matter, 11; water, 3=100.—Settled clear in two hours.

Clay alluvion.—Siliceous soil, 48; alluminous, 39; carbonate of lime, 2; soluble salts, 2; animal and vegetable matter, 5; water, 4=100.—Settles clear in twenty-six hours.

NOTE. If the oxyd of iron is sought, most soils will yield from 1 to 3 per cent.

WEIGHT OF GASES.—Atmospheric air being assumed as the standard or unity, 100 cubic inches, weighing 30 grains and 20 hundredths of a grain. Atmospheric air, 1.000; oxygen, 1.117; nitrogen, 0.968; hydrogen, 0.074; carbonic acid gas, 1.542; ammonia, 0.596; sulphuretted hydrogen, 1.192; carburetted hydrogen, (olefiant) 0.998; coal gas, 0.450; phosphuretted hydrogen, 1.894; chlorine, 2.495; muriatic acid, 1.285; nitrous

oxyd, (exhilarating gas,) 1.527; nitric oxyd, 1.043; nitrous acid, 2.135; sulphurous acid, 2.235; prussic acid, (hydrocyanic,) 0.946; water in vapour, 0.623; alcohol in vapour, 1.500; sulphuric ether in vapour, 2.396; spirits of turpentine in vapour, 5.013.

WEIGHT OF LIQUIDS.—*Water being assumed as the standard or unity.* Sulphuric ether, 0.76; nitric ether, 0.90; alcohol, 0.81; proof spirits, 0.93; distilled vinegar, 1; muriatic acid concentrated, 1.17; sulphuric acid, 1.84; nitric acid, 1.42; fuming nitrous and nitric acid, 1.50.

WEIGHT OF SOLIDS.—*Water being assumed as the standard or unity.* Potassium, 0.85; sodium, 0.97; lime, 2.3; barytes, 4.; strontian, 3.7; magnesia, 2.3; sillex, 2.66; alumine, 2; iron, 7.78; manganese, 6.85; tin, 7.3; zinc, 7.; cadmium, 8.6; arsenic, 9.35; chrome, 5.9; molybdena, 7.4; tungsten, 17.5; Columbium, 5.91; copper, 8.9; antimony, 6.7; bismuth, 9.8; cobalt, 8.; red oxyd of titanium, 4.2; tellurium, 6.1; red oxyd of cerium, 4.9; uranium, 9.; gold, 19.3; silver, 10.5; platina, 21.; palladium, 11.; rhodium, 11.; iridium, 19.52; osmium, unknown; mercury, 13.5; lead, 11.35; nickel, 8.25.

PROPORTIONS OF ELEMENTARY CONSTITUENTS.

BINARY COMPOUNDS.—The oxygen 10 in all, excepting ammonia. Water, 1.32 hydrogen; carbonic acid, 3.77 carb.; sulphuric acid, 6.66 sulphur; phosphoric acid, 8.7 phos.; nitric acid, 3.51 nit.; chlorine, 31.1 mur. acid; ammonia, 17.54 nit. 396 hyd.; soda, 29.1 sodium; potash, 49.1 potassium; magnesia, 14.6 magnesium; lime, 25.46 calcium; red oxyd of iron, 23 iron; green oxyd of iron, 34.5 iron; black oxyd of copper, 40 copper; oxyd of zinc, 41 zinc; red oxyd of mercury, 125.5 mercury; black oxyd of mercury, 251 mercury; litharge, 129.5 lead; oxyd of silver, 135 silver.

TERNARY COMPOUNDS.—Subcarbonate of ammonia, 27.5 acid to 21.5 am.; sub-carbonate of soda, 27.5 carb. ac. to 39.1 soda; sub-carbonate of potash, 27.5 acid to 59.1 potash; carbonate of lime, 27.54 carb. acid to 35.46 lime; carbonate of barytes, 27.5 acid to 97 barytes; sulphate of soda, 50 acid to 39.1 soda; sulphate of magnesia, (dry) 50 acid to 24.6 magnesia; ditto crystallized, 74.6 sul. mag. to 79.3 water; sulphate of barytes, 50 acid to 97 barytes; sulphate of copper, 50 acid to 50 copper, to 56.6 water; sulphate of iron, 50 acid to 34.5 iron to 79.3 water; sulphate of zinc, 50 acid to

51 zinc to 79.3 water; nitrate of potash, 67.54 acid to 59.1 potash; muriate of ammonia, 34.1 acid to 21.5 am. to 11.32 water; muriate of soda, 34.1 acid to 39.1 soda; muriate of potash, 34.1 acid to 59.1 potash; oxymuriate of potash, 93.2 mur. pot. to 60 oxygen; muriate of lime, 34.1 acid to 35.5 lime; muriate of barytes, 34 acid to 97 barytes; cor. muriate of mercury, 34.1 acid to 10 ox. to 125.5 merc.; sub-muriate of ditto, 34 acid to 10 ox. to 251 merc.; sulphate of lime, (dry) 50 acid to 35.5 lime; ditto crystallized, 85.5 sul. lime to 22.4 water.

EFFECTS OF HEAT AT THE DIFFERENT DEGREES OF FAHRENHEIT.—90 degrees (*below zero*) the greatest degree of artificial cold; 55 nitric acid freezes; 50 natural cold at Hudson's Bay; 46 ether, and strong liquid ammonia freeze; 39 merc. freezes; 36 sulphuric acid freezes; 0 cold produced by equal parts of snow and salt; 25 (*above zero*) human blood freezes; 30 milk freezes; 32 water and oxymuriatic acid freeze; 67 water boils in a vacuum; 97 lard melts; 98 blood heat, ether boils; 107 feverish heat; 122 phosphorus burns; 127 tallow melts; 142 beeswax melts; 176 alcohol boils; 212 water boils; 442 tin melts; 476 bismuth melts; 540 arsenic is volatilized; 590 sulphuric acid boils; 612 lead melts; 644 mercury boils; 700 zinc melts; 809 antimony melts; 1077 iron red by day-light; 1892 silver melts; 2205 copper melts; 2517 gold melts; 6508 iron welding hot; 8696 cast iron melts; 10517 manganese melts; 11454 soft iron melts; 23177 platina melts.

MISCELLANEOUS EXPERIMENTS.

Experiment 1.—Mix alcohol and water, or sulphuric acid and water. The qualities and sensible properties of both these liquids will remain unchanged. Being diffused among the water, there will be less of them in a given measure or space, but they will remain unchanged.

Rationale.—The combination is not a mere mechanical suspension, like clay diffused in water, because they will never settle down at the bottom of the water. It must therefore be a chemical compound.

Application.—Proof spirit, brandy, gin, &c. are made by combining alcohol with water. If more water is added, as in forming what is called grog, still the alcohol is not changed. Caloric unites with ice, forming water, and with water, forming steam, without changing the nature of the water. But the proportion is definite

for changing ice to water and water to steam; and here the change of the state of it seems to bear a suitable proportion to the definite proportion of caloric.

Experiment 2.—Lay a piece of ice on a hot stove, or fire shovel, it will soon receive caloric sufficient to become water. Let it remain a little longer, and it will become vapour, and pass off into the air.

Rationale.—The particles of water, in the state of ice were fixed; but caloric being introduced between them, caused them to move freely among each other, and thus become liquid. More caloric being introduced, the particles were separated so widely as to form vapour or steam.

Application.—When a kettle of water is placed over the fire, the particles of water next to the bottom, first receive caloric enough to become vapour or steam, and attempt to ascend; but the colder water above robs them of a portion of caloric, and forces them to remain in the liquid state. When all the water in the kettle has received very nearly the quantity of caloric required for converting the whole into vapour, the particles next to the bottom being converted into steam, succeed in ascending to the top and passing off. A succession of such ascending particles of vapour, keeps up the bubbling called boiling.

Experiment 3.—Scratch and blacken with lamp-smoke, one side of a small tin canister. Fit it to a stand, so that the blackened and polished sides may be readily set at the distance of half an inch from the same side of the bulb of an air thermometer. Now fill the canister with hot water, and present the polished and blackened sides of it alternately to the thermometer several times. The liquid will always sink the lowest when the blackened side is presented.

Rationale.—As the caloric is transmitted through the rough blackened side, with the greatest facility, or rather meets with less obstruction than in passing through the polished side, the air in the bulb of the thermometer receives more caloric from the water in a given time, and is consequently more expanded.

Application.—A white earthen tea-pot will keep the tea hot longer than a black one. A bright tin coffee-pot will keep the coffee hot longer than a japanned one. Light coloured clothes will keep us cooler in hot weather, and warmer in cold weather, than dark coloured. For our bodies being warmer than the air in cold weather, caloric passes out through our clothes; but the

hot rays of the sun in summer pass through our clothes inwardly.

Experiment 4.—Suspend a heated iron ball by a wire, and hold an air thermometer on all sides of it, in succession. It will be found to be equally affected at equal distances.

Rationale.—As the thermometer is equally affected on all sides at equal distances, it follows that its radiation is equal in all directions.

Application.—A stove set in or near the centre of the room, will afford as much warmth on each of all its sides, as it would on the one exposed side, if set in a side fire place.

Experiment 5.—Rub two pieces of white quartz slightly together in the dark, and they will become luminous.

Rationale.—In this case nothing like the scintillations of flint and steel is the cause of the luminous appearance. Neither is there any phosphorus in combination with common quartz. This and some other minerals either absorb light and give it off when rubbed, or possess a peculiar property, which cannot be referred to any classification of the phenomena of light.

Application.—Some bodies absorb and give off light, as rotten wood, putrid fish, some artificial preparations, &c. Snow absorbs light by day, which it gives off by night, which may be demonstrated by opening a window in a dark night and the room will be actually illuminated considerably.

Experiment 6.—Fill a glass cylinder with chlorine gas. Immerse a short piece of burning candle in it, held upright by a wire. It will burn a short time with a deep coloured flame and a dense smoke.

Fill the cylinder again, and immerse in it a small piece of phosphorus, suspended in a coil of wire. It will take fire and burn spontaneously.

Fill the cylinder again, and immerse in it gold, silver, and copper leaf; they will soon take fire spontaneously. Brass or copper wire will burn in this gas, if immersed in a vial of it when heated to redness in a candle. For all these experiments, the gas must be just made and kept warm.

Experiment 7.—Put a few scales of iodine into a tea-spoon of alcohol in a wine glass, it will give a reddish purple colour. Put a few scales into a solution of starch, and it will give a dark purple colour. Put a few scales on a bright silver dollar and it will give an iridescent hue. Rub a few scales between the fingers, and it will give to the skin a dirty yellow colour.

Rationale.—We can only refer these results to the general proposition under light; that different colours depend on the different arrangement of constituent atoms.

Application.—The above solution in alcohol is used by physicians in scrofula. The other combinations are subjects of curiosity only.

Experiment 8.—Fill a glass cylinder with hydrogen gas. Raise it up slowly, still retaining it in its inverted position, and carefully settle it down over a candle. When the gas touches the flame it will slightly explode. After it is so far settled down over the candle as to bring the wick within the gas, it will be extinguished.

Experiment 9.—Lay a piece of ice on water and it will float. Glass vessels are broken in which water is left to freeze, unless they diverge upwards, so much as to allow the ice to rise up, when the freezing process commences.

Experiment 10.—Fill two tumblers almost full of water. Let the water of one tumbler be pure, and that of the other contain as much common salt as it will hold at the temperature of pretty cool water. Attach a piece of lead to a small block of wood, whittling off from either the lead or the wood, until it will barely float in the tumbler of salt water. Now put it into the tumbler of fresh water, and it will sink to the bottom.

Rationale.—Salt being strongly attracted by water, combines with it closely, and probably enters the interstices between its particles, giving it a more dense consistency, of course greater specific gravity.

Application.—A ship will swim in the ocean with a freight so heavy, that it would sink if sailed into a fresh water river. Persons cast away at sea can swim much easier than they could in fresh water, because the greater specific gravity of the water will help to buoy them up.

Experiment 11.—Put a little common table salt into a wine glass, and pour on it strong sulphuric acid, sufficient to wet it. Muriatic acid gas will be disengaged, and condense aqueous vapour, so as to become visible and appear like steam.

Experiment 12.—Melt a little common potash in an iron ladle, then put into it small bits of fresh meat and woollen rags, and boil them a short time. The rags and meat will be dissolved and soap will be formed.